

IN THE CLAIMS:

Claims 14, 18, 38, and 40-45 were previously cancelled. Claims 1, 2, 19, 21, 22, 46 and 47 have been amended herein. All of the pending claims are presented below. This listing of claims will replace all prior versions and listings of claims in the application. Please enter these claims as amended.

Listing of Claims:

1. (Currently Amended) A method of forming chip-scale packages, ~~comprising;~~
comprising:
providing a semiconductor wafer having an active surface with a plurality of semiconductor die locations separated by at least one street of semiconductor material and having a passive surface opposite the active surface;
cutting at least one channel in the active surface of the semiconductor wafer along the at least one street of semiconductor material to expose a plurality of semiconductor die side surfaces;
etching the plurality of semiconductor die side surfaces to remove a layer of semiconductor material containing cutting-induced defects;
forming a first protective coating on the semiconductor wafer to cover the active surface and fill the at least one channel;
removing a layer of semiconductor material from the passive surface of the semiconductor wafer to a depth sufficient to expose the first protective coating within the at least one ~~channel;~~
and channel;
etching the passive surface of the semiconductor wafer such that the first protective coating exposed within the at least one channel forms at least one frame element protruding from the passive surface of the semiconductor wafer;
forming a second protective coating on the semiconductor wafer to cover the passive surface; such that the second protective coating is anchored to the passive surface of the semiconductor wafer with the at least one frame element; and

separating the semiconductor wafer along the at least one channel to form a plurality of individual chip-scale packages.

2. (Currently Amended) The method of claim 1, wherein cutting the at least one channel in the active surface of the semiconductor wafer comprises cutting the at least one channel with one of a dicing saw and a laser beam.

3. (Original) The method of claim 1, wherein forming the first protective coating on the semiconductor wafer comprises:
applying a liquid polymer material over the active surface of the semiconductor wafer; and
at least partially curing the liquid polymer material.

4. (Original) The method of claim 3, wherein applying the liquid polymer material comprises one of spraying or spin coating the liquid polymer material onto the active surface of the semiconductor wafer.

5. (Original) The method of claim 4, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising:
etching a portion of the first protective coating to expose the at least one bond pad of each semiconductor die location.

6. (Original) The method of claim 3, wherein the liquid polymer material comprises a photocurable liquid polymer material, and further comprising:
exposing the photocurable liquid polymer material to a source of electromagnetic radiation to at least partially cure a portion of the photocurable liquid polymer material.

7. (Original) The method of claim 6, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising:
selectively curing the photocurable liquid polymer material to leave the at least one bond pad of each semiconductor die location exposed through the first protective coating.

8. (Original) The method of claim 1, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising:
forming a conductive bump on the at least one bond pad of each semiconductor die location.

9. (Original) The method of claim 8, wherein forming the conductive bump on the at least one bond pad comprises forming the conductive bump prior to forming the first protective coating on the semiconductor wafer.

10. (Original) The method of claim 9, wherein forming the first protective coating comprises:
spraying or spin coating a liquid polymer material onto the active surface of the semiconductor wafer; and
at least partially curing the liquid polymer material.

11. (Original) The method of claim 10, further comprising:
etching a portion of the first protective coating to expose the conductive bump on the at least one bond pad of each semiconductor die location.

12. (Original) The method of claim 9, wherein forming the first protective coating comprises:
applying a photocurable liquid polymer material over the active surface of the semiconductor wafer; and
exposing the photocurable liquid polymer material to a source of electromagnetic radiation to at least partially cure a portion of the photocurable liquid polymer material.

13. (Original) The method of claim 12, further comprising:
selectively curing the photocurable liquid polymer material to leave the conductive bump on the at least one bond pad of each semiconductor die location exposed through the first protective coating.

14. (Canceled)

15. (Previously Presented) The method of claim 1, wherein removing the layer of semiconductor material comprises planarizing the passive surface of the semiconductor wafer with at least one of a mechanical process and a chemical process.

16. (Original) The method of claim 15, wherein removing the layer of semiconductor material comprises backgrinding the passive surface of the semiconductor wafer.

17. (Original) The method of claim 15, wherein removing the layer of semiconductor material comprises a CMP process.

18. (Canceled)

19. (Currently Amended) The method of claim 1, wherein each semiconductor die location of the plurality of semiconductor die locations comprises a plurality of circuit layers extending a depth into the semiconductor wafer from the active surface of the semiconductor wafer, and wherein cutting the at least one channel in the active surface of the semiconductor wafer comprises cutting the at least one channel to a depth that is greater than the depth of the circuit layers within the semiconductor wafer.

20. (Original) The method of claim 1, wherein etching the plurality of semiconductor die side surfaces comprises etching the plurality of semiconductor die side surfaces with an anisotropic etching process.

21. (Currently Amended) A method of forming chip-scale packages, ~~comprising~~
comprising:
providing a semiconductor wafer having an active surface with a plurality of semiconductor die locations separated by at least one street of semiconductor material;
forming a first protective coating on the semiconductor wafer to cover the active surface;
cutting at least one channel in a passive surface of the semiconductor wafer along the at least one street of semiconductor material to expose a plurality of semiconductor die side surfaces;
etching the plurality of semiconductor die side surfaces to remove a layer of semiconductor material containing cutting-induced defects and to expose the first protective coating within the at least one channel;
forming a second protective coating on the semiconductor wafer to cover the passive surface and fill the at least one channel; and
separating the semiconductor wafer along the at least one channel to form a plurality of individual chip-scale packages.

22. (Currently Amended) The method of claim 21, wherein cutting the at least one channel in the passive surface of the semiconductor wafer comprises cutting the at least one channel with one of a dicing saw and a laser beam.

23. (Original) The method of claim 21, wherein forming the first protective coating on the semiconductor wafer comprises:
applying a liquid polymer material over the active surface of the semiconductor wafer; and
at least partially curing the liquid polymer material.

24. (Original) The method of claim 23, wherein applying the liquid polymer material comprises one of spraying or spin coating the liquid polymer material onto the active surface of the semiconductor wafer.

25. (Original) The method of claim 24, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising:
etching a portion of the first protective coating to expose the at least one bond pad of each semiconductor die location.

26. (Original) The method of claim 23, wherein the liquid polymer material comprises a photocurable liquid polymer material, and further comprising:
exposing the photocurable liquid polymer material to a source of electromagnetic radiation to at least partially cure a portion of the photocurable liquid polymer material.

27. (Original) The method of claim 26, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising:
selectively curing the photocurable liquid polymer material to leave the at least one bond pad of each semiconductor die location exposed through the first protective coating.

28. (Original) The method of claim 21, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising:
forming a conductive bump on the at least one bond pad.

29. (Original) The method of claim 28, wherein forming the conductive bump on the at least one bond pad comprises forming the conductive bump prior to forming the first protective coating on the semiconductor wafer.

30. (Original) The method of claim 29, wherein forming the first protective coating comprises:
spraying or spin coating a liquid polymer material onto the active surface of the semiconductor wafer; and
at least partially curing the liquid polymer material.

31. (Original) The method of claim 30, further comprising:
etching a portion of the first protective coating to expose the conductive bump on the at least one bond pad of each semiconductor die location.

32. (Original) The method of claim 29, wherein forming the first protective coating comprises:
applying a photocurable liquid polymer material over the active surface of the semiconductor wafer; and
exposing the photocurable liquid polymer material to a source of electromagnetic radiation to at least partially cure a portion of the photocurable liquid polymer material.

33. (Original) The method of claim 32, further comprising:
selectively curing the photocurable liquid polymer material to leave the conductive bump on the
at least one bond pad of each semiconductor die location exposed through the first
protective coating.
34. (Original) The method of claim 21, further comprising:
removing a layer of semiconductor material from the passive surface of the semiconductor wafer
prior to forming the second protective coating on the semiconductor wafer.
35. (Original) The method of claim 34, wherein removing the layer of semiconductor
material comprises planarizing the passive surface of the semiconductor wafer with at least one
of a mechanical process and a chemical process.
36. (Original) The method of claim 35, wherein removing the layer of semiconductor
material comprises backgrinding the passive surface of the semiconductor wafer.
37. (Original) The method of claim 35, wherein removing the layer of semiconductor
material comprises a CMP process.
38. (Canceled)
39. (Original) The method of claim 21, wherein etching the plurality of
semiconductor die side surfaces comprises etching the plurality of semiconductor die side
surfaces with an anisotropic etching process.
- 40.-45. (Canceled)

46. (Currently Amended) A method of forming chip-scale packages, ~~comprising~~
comprising:
providing a semiconductor wafer having an active surface with a plurality of semiconductor die
locations separated by at least one street of semiconductor material;
forming a first protective coating on the semiconductor wafer to cover the active surface;
cutting at least one channel in a passive surface of the semiconductor wafer along the at least one
street of semiconductor material to expose a plurality of semiconductor die side surfaces;
etching the plurality of semiconductor die side surfaces to remove a layer of semiconductor
material containing cutting-induced defects and to expose the first protective coating
within the at least one channel;
planarizing the passive surface of the semiconductor wafer with at least one of a mechanical
process and a chemical process to remove a layer of semiconductor material from the
passive surface of the semiconductor wafer, wherein ~~planarizing~~ planarizing and etching
the plurality of semiconductor die side surfaces occur concurrently;
forming a second protective coating on the semiconductor wafer after removing the layer of
semiconductor material to cover the passive surface and fill the at least one channel; and
separating the semiconductor wafer along the at least one channel to form a plurality of
individual chip-scale packages.

47. (Currently Amended) The method of claim 46, wherein cutting the at least one
channel in the passive surface of the semiconductor wafer comprises cutting the at least one
channel with one of a dicing saw and a laser beam.

48. (Previously Presented) The method of claim 46, wherein forming the first
protective coating on the semiconductor wafer comprises:
applying a liquid polymer material over the active surface of the semiconductor wafer; and
at least partially curing the liquid polymer material.

49. (Previously Presented) The method of claim 48, wherein applying the liquid polymer material comprises one of spraying or spin coating the liquid polymer material onto the active surface of the semiconductor wafer.

50. (Previously Presented) The method of claim 49, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising: etching a portion of the first protective coating to expose the at least one bond pad of each semiconductor die location.

51. (Previously Presented) The method of claim 48, wherein the liquid polymer material comprises a photocurable liquid polymer material, and further comprising: exposing the photocurable liquid polymer material to a source of electromagnetic radiation to at least partially cure a portion of the photocurable liquid polymer material.

52. (Previously Presented) The method of claim 51, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising: selectively curing the photocurable liquid polymer material to leave the at least one bond pad of each semiconductor die location exposed through the first protective coating.

53. (Previously Presented) The method of claim 46, wherein each semiconductor die location of the plurality includes at least one bond pad, and further comprising: forming a conductive bump on the at least one bond pad.

54. (Previously Presented) The method of claim 53, wherein forming the conductive bump on the at least one bond pad comprises forming the conductive bump prior to forming the first protective coating on the semiconductor wafer.

55. (Previously Presented) The method of claim 54, wherein forming the first protective coating comprises:
spraying or spin coating a liquid polymer material onto the active surface of the semiconductor wafer; and
at least partially curing the liquid polymer material.

56. (Previously Presented) The method of claim 55, further comprising:
etching a portion of the first protective coating to expose the conductive bump on the at least one bond pad of each semiconductor die location.

57. (Previously Presented) The method of claim 54, wherein forming the first protective coating comprises:
applying a photocurable liquid polymer material over the active surface of the semiconductor wafer; and
exposing the photocurable liquid polymer material to a source of electromagnetic radiation to at least partially cure a portion of the photocurable liquid polymer material.

58. (Previously Presented) The method of claim 57, further comprising:
selectively curing the photocurable liquid polymer material to leave the conductive bump on the at least one bond pad of each semiconductor die location exposed through the first protective coating.

59. (Previously Presented) The method of claim 46, wherein etching the plurality of semiconductor die side surfaces comprises etching the plurality of semiconductor die side surfaces with an anisotropic etching process.